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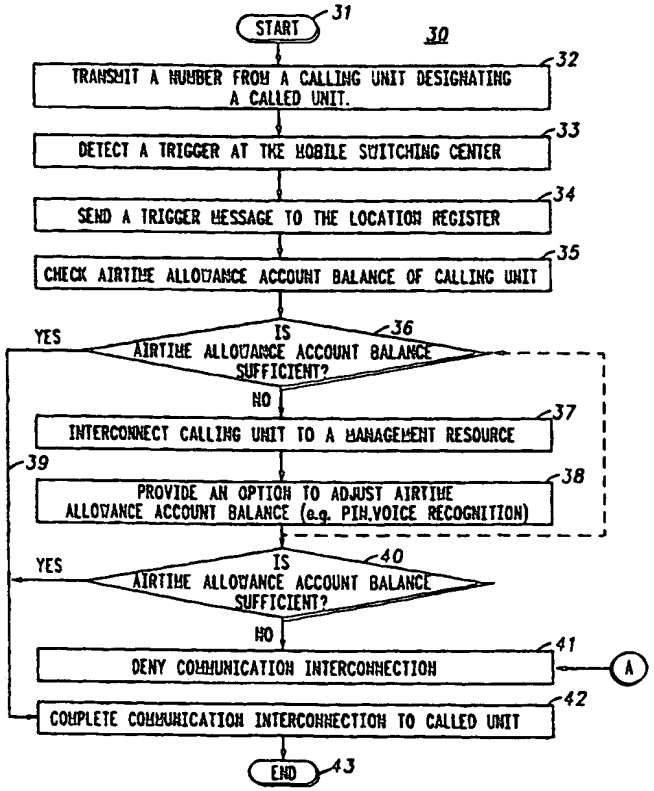
(54) Title: METHOD OF MAKING A COMMUNICATION INTERCONNECTION

(57) Abstract

A number is transmitted from a calling unit designating a called unit (218). The account balance of the calling unit (216) is checked. If the account balance is sufficient, a communication interconnection to the called unit (218) is made. If the account balance is insufficient, the calling unit (216) is interconnected to a management resource where an option to adjust the account balance is provided. Subsequently, the communication interconnection is completed if the account balance is adjusted and sufficient.



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METHOD OF MAKING A COMMUNICATION INTERCONNECTION

FIELD OF THE INVENTION

The present invention relates generally to communication systems and, more particularly, to a method of making a communication interconnection.

BACKGROUND OF THE INVENTION

Communication systems consisting of land mobile radio, cellular radiotelephone, personal communication system, and various other types are well known. A typical multiple access wireless communication system such as a digital radio frequency (RF) radiotelephone system includes a base station system, (BSS), having one or more base station transmitters and receivers, commonly referred to as base transceiver stations (BTS), and a base station controller (BSC). The BSS communicates via a radio frequency (RF) channel with a mobile communication unit, commonly referred to as a mobile station (MS), operating within an area served by at least one BTS. The BSCs are in turn, linked to mobile switching centers (MSC) which provide a connection between the multiple access wireless communication system and the public switched telephone network (PSTN) as well as interconnection of various cellular radiotelephone communication systems.

One such multiple access wireless communication system is a direct sequence code division multiple access (DS-CDMA) cellular communication systems, such as set forth in the TIA Interim Standard (IS)-95A, Mobile Station-Base Station Compatibility Standards for Dual-Mode Wideband Spread Spectrum Cellular Systems, Telecommunications Industry Association, Washington, D. C. July

1993 [IS-95A] incorporated herein by reference. According to these standards, coded communication signals are transmitted in common 1.25 megahertz (MHz) carriers between base stations and mobile stations that are communicating in the service coverage areas of the base stations.

The MSC of a multiple access wireless communication system is typically a complex system integrating telephony switching elements with radiotelephone communication system-specific aspects such as signaling, control, etc. As a result, the expense and development time associated with introducing new subscriber services or features through modifications at the MSC level led to the telecommunications industry recently developing a next generation network design called Advanced Intelligent Network (AIN). Such an architecture is described in Bellcore's Advanced Intelligent Network (AIN) 0.2 Switching Systems Generic Requirements, GR-1298-CORE, November 1993 and is incorporated herein. Use of AIN architecture has allowed new subscriber features, for example, prepayment of communication services such as prepaid communication connections for a bulk rate, or prepaid credit card type billing, to be facilitated by the use of peripheral computer systems in communication with one or more MSCs.

Currently, there exists multiple methods for prepayment of communication services. According to one known method for prepayment of communication services, monetary value data representative of a prepaid amount of money available for payment of mobile station airtime, is deposited in a central switching system by a registered group of subscribers. As telecommunication interconnections are made and terminated, the central switching system decrements the prepaid monetary value. The group of subscribers, however, do not have the ability to directly modify the prepaid monetary value available for the mobile station calls in a real-time environment, e.g. during call origination or termination. A

detailed description of prepayment of communication services may be found in U.S. Patent No.5,359,642 to Castro.

In a further example, an airtime debit card, for example, a Smart Card or a SIM Card, may be issued to a mobile station subscriber. The airtime debit card has the ability to store a prepaid monetary value or account balance, and upon insertion into a mobile station, contains circuitry and software capable of decrementing the account balance or blocking phone calls if an insufficient balance is detected.

Prepayment, increasing or decreasing, a mobile station airtime account, is typically accomplished by the service provider upon receipt of payment or non-payment by the mobile station subscriber. Moreover, pre-payment of mobile station airtime as it currently exists, does not allow the mobile station subscriber to directly monitor and control the amount of money spent on monthly airtime charges, as the calling or called party, [without interaction with the service provider]] during call origination or termination. As a result, a secondary user of the mobile station, for example a child, may deplete the airtime allowance, unbeknownst to the mobile station subscriber.

Therefore, a need exists for a method of making a communication interconnection directly between the mobile station subscriber and an element of the communication system such that airtime allowance may be queried and/or modified by the subscriber during call set-up.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 depicts a typical prior art wireless communication system.

FIG. 2 is a block diagram of a wireless communication system according to a preferred embodiment of the present invention.

FIG. 3 is a flow chart illustrating a method of making a communication interconnection, in accordance with a preferred embodiment of the present invention.

FIG. 4 is a flow chart further detailing operation of the method depicted in FIG. 3.

FIG. 5 is a flow chart illustrating a method of making a communication interconnection, in accordance with a second embodiment of the present invention.

FIG. 6 is a flow chart further detailing the method depicted in FIG. 5.

FIG. 7 is a flow chart illustrating a method of making a communication interconnection, in accordance with a third embodiment of the present invention.

FIG. 8 is a flow chart illustrating a method of making a communication interconnection, in accordance with a fourth embodiment of the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Turning now to the drawings, wherein like numerals designate like components, FIG. 1, a wireless communication system 200, such as a direct sequence code division multiple access (DS-CDMA) digital radiotelephone system is shown. Base stations 210, 212, and 214 may communicate with mobile station 216, via radio frequency (RF) channels which provide physical paths over which communication signals such as voice, data, and video are transmitted, operating within coverage area 220. Similarly, base stations 210, 212, and 214 may communicate with a mobile station 218 operating within coverage area 224. Base station locations are chosen to provide overlapping coverage areas. Base stations 210, 212, and 214, are coupled to a base station controller (BSC) 250, which includes, among other things, a processor 262 and a memory 264 and which is in turn is coupled to a mobile switching center (MSC) 260, also including, among other things, a processor 262 and a memory 264. A BSC 250 and its associated base stations, such as base stations 210, 212, and 214, may be referred to as a base station system (BSS). MSC 260 is coupled to PSTN 270. Calls originating with or terminating at mobile station 216 are processed through MSC 260 to either a wireline customer linked to the public switched telephone network (PSTN) 270 or other radiotelephone communication system users serviced by MSC 260 or other MSCs (not shown). The BSC and MSC operate according to well known methods and are commercially available from Motorola, Inc.

In an advanced intelligent network (AIN) 300 shown in FIG. 2, MSC 260 is in communication with a visitor location register (VLR) 302 via signaling link 301. VLR 302 is dedicated to MSC 260 although a VLR may serve more than one MSC. MSC 260 is also in

communication with a home location register (HLR) 304 via signaling link 306. HLR 304 may be in communication with multiple MSCs. MSC 260 may also be in communication with multiple HLRs supporting different subscribers. Unlike MSC 260, HLR 304 and VLR 302 have no voice transmission, reception or switching facilities, but are essentially databases which, among other things, store the location and service profile information of mobile station subscribers.

In AIN 300, VLR 302 and HLR 304 may be considered to be peripheral computer systems, commonly referred to as service control points (SCP). In AIN 300, "intelligent" operations are transferred out of the existing network of MSCs and into the peripheral computer systems. The essence of a communication system constructed in accordance with AIN 300, is that delivering subscriber calling and data services, and features, may be provided by the peripheral computer systems, therefore greatly reducing the time to develop and implement new subscriber services in MSC 260.

Within MSC 260, essential call processing such as establishing, maintaining and clearing calls are represented by points in call (PICs), much like a state diagram. Detection points (DPs), which are identified between PICs, identify when a SCP can receive notification of a given event and subsequently influence call processing. A DP maybe classified as a trigger detection point (TDP) when predefined AIN trigger criteria have been met. For example, a TDP, much like a "flag", may identify when HLR 304 will receive notification of a given event. If during call processing at a given DP, MSC 260 determines that an AIN process is not needed or that the trigger criteria is not satisfied, it continues to process the call normally. Whereas, if MSC 260 determines that the trigger criteria is satisfied, it sends a message or data package to a peripheral computer system such as HLR 304.

Generally, VLR 302/HLR 304 receives messages or data packages from MSC 260 when MSC 260 requires assistance in routing a call or providing a feature. MSC 260 may be configured such that it sends the

specific trigger message to HLR 304 when MSC 260 encounters a trigger detection point during call processing.

HLR 304 is in communication with VLR 302 via signaling link 308 in order to provide and update mobile station subscriber information, also referred to as temporary subscriber profile information, from HLR 304 to VLR 302. Signaling links 301, 306, and 308 are preferably out-of-band, bi-directional, signaling links, for common channel signaling system 7 (e.g. signaling system 7 (SS7), the European equivalent of signaling system 7 (C7), or the Japanese equivalent of signaling system 7 (J7)), able to support standard messaging protocol such as Interim Standard 41 (IS-41), published by the US Telecommunications Industry Association (TIA), between MSC 260, HLR 304 and VLR 302.

In addition, HLR 304 may delegate many of its tasks to intelligent peripherals (IPs). An intelligent peripheral, for example a voice response unit (VRU) 312 commercially available from Centigram, Inc., may provide selectable information interactions within multiple access wireless communication system 200. VRU 312 is used in place of, or in addition to, an intelligent peripheral in order to, when requested, provide, for example, an interactive audio recording to a mobile station subscriber. Although HLR 304 may defer a small portion of the service logic processing to VRU 312, it immediately regains control of the service logic processing after the VRU 312 executes its task, much like a master-slave processor relationship.

Signaling link 310, between VRU 312 and HLR 304 may be a voice response interface (VRI) application protocol which is carried in the data portion of a transmission control protocol/internet protocol (TCP/IP) packet. Additionally, a voice/data trunk (e.g. a T1, fiber optic etc.), provides an audio link 314 between VRU 312 and MSC 260.

In FIG. 3, a flow chart representing a method, generally designated 30, of making a communication interconnection is illustrated. Method 30 starts at block 32 where a number designating

called unit 218, is transmitted from a calling unit 216. During call processing by MSC 260, an AIN trigger point is detected at step 33. Subsequently, MSC 260 forwards a trigger message to HLR 304 at step 34. Next, upon receipt of the trigger message, HLR 304 checks an airtime allowance account balance of calling unit 216 , at step 35. At step 36, if, upon checking HLR 304 by MSC 260 in accordance with standard AIN trigger processing, HLR 304 determines that the airtime allowance of mobile station 216 is sufficient, "sufficient" defined by the communication system operator, the communication interconnection to called unit 218 is completed, step 42. If the airtime allowance account balance of calling unit 216 is insufficient, HLR 304 may direct MSC 260 to direct the communication interconnection to a management resource in communication system 200, step 37, in order to verify and adjust the airtime allowance of mobile station 216. The service logic that controls the management resource may be resident in VLR 302, HLR 304, VRU 312, or any other appropriate management resource capable of providing an option to adjust the airtime allowance of mobile station 216.

At step 38, the subscriber using calling unit 216 is provided with an option to adjust its airtime allowance account balance, and is further described in FIG. 4. The option to adjust the airtime allowance account balance of mobile station 216 may be facilitated via an audio link 314 (discussed previously in connection with FIG. 2). Audio link 314 is established between MSC 260 and VRU 312 upon determination that the airtime allowance account balance of mobile station 216 is insufficient. This option may be initiated by an entry, by the subscriber using mobile station 216, of a dual tone multi frequency (DTMF) personal identification number or a voice recognized pattern. VRU 312 then passes the entry to HLR 304 for validation. Upon successful validation, HLR 304 sends the airtime allowance account balance of mobile station 216 to VRU 312 to be played in an announcement to the subscriber of mobile station 216. At step 50, a management resource

such as HLR 304 will allow the subscriber using mobile station 216 to perform a modification (increase or decrease) of airtime allowance via audio interaction with VRU 312. At step 51, the subscriber using mobile station 216 instructs that the airtime allowance account balance be adjusted. Prompted by VRU 312, the subscriber using mobile station 216 may then enter the information necessary to adjust that the airtime allowance account balance of mobile station 216. Subsequent to the adjustment of the airtime allowance account balance by the subscriber of mobile station 216 at step 52, VRU 312 passes the information to HLR 304. HLR 304 uses the information to update the airtime allowance account balance parameter.

Returning to FIG. 3, at block 40, if after adjustment, the airtime allowance account balance of calling unit 216 is insufficient, HLR 304 directs MSC 260 to deny the communication interconnection between calling unit 216 and called unit 218 at step 41. Alternately, if after adjustment, the airtime allowance account balance of calling unit 216 is insufficient, VRU 312 may prompt the subscriber of calling unit 218 again to adjust its airtime allowance account balance by returning to decision step 36 At step 42, subsequent to successful completion of the adjustment of airtime allowance account balance by the subscriber using calling unit 216, the communication interconnection between calling unit 216 and called unit 218 may be completed if the airtime allowance account balance is sufficient. In addition, HLR 304 will store the new airtime allowance parameter.

In an alternate embodiment of the present invention, FIG. 5 shows another method of making a communication interconnection. At step 62, MSC 260 receives a request for a communication interconnection from calling unit 216, the request designating called unit 218. At step 63, during call processing of the received request, by MSC 260, a trigger point is detected, activating a trigger message. Subsequently, MSC 260 forwards the trigger message to HLR 304, at step 64. Next, upon receipt of the trigger message, HLR 304 checks an

airtime allowance account balance of called unit 218, at step 65. At step 66, if the airtime allowance account balance of called unit 218 is sufficient, the communication interconnection to called unit 218 is completed at step 72. However, at step 67, if the airtime allowance account balance of called unit 218 is insufficient, HLR 304 may direct MSC 260 to direct the communication interconnection to a management resource and to send a message to called unit 218.

At step 68, the subscriber using called unit 218 is provided with an option to adjust its airtime allowance account balance. This step is further described with reference to FIG. 6. At step 80, a management resource such as HLR 304 allows the subscriber to modify (increase or decrease) its airtime allowance account balance via an interactive audio recording furnished by VRU 312. VRU 312 requests whether the subscriber using called unit 218 desires to adjust the airtime allowance account balance, decision step 80. Next at step 81, the subscriber of called unit 218 indicates that he/she desires to adjust the airtime allowance account balance either by entry of a DTMF personal identification number or a voice recognized pattern. VRU 312 then passes the entry to HLR 304 for validation. Upon successful validation, HLR 304 sends the airtime allowance account balance of called unit 218 to VRU 312 to be played in an announcement to the subscriber. Prompted by VRU 312, the subscriber may then enter the information necessary to adjust that the airtime allowance account balance via an appropriate method, for example using DTMF digits or voice. Subsequent to the adjustment of the airtime allowance account balance at step 82, VRU 312 passes the information to HLR 304 to update the airtime allowance account balance parameter.

Returning to FIG. 5, at decision step 70, if after adjustment, the airtime allowance account balance of is insufficient, HLR 304 directs MSC 260 to deny the communication interconnection between calling unit 216 and called unit 218 at block 71. Alternately, if after adjustment, the airtime allowance account balance of called unit 218 is insufficient,

VRU 312 may prompt the subscriber of called unit 218 again to adjust its airtime allowance account balance by returning to step 66. If the airtime allowance account balance is sufficient, step 70, the communication interconnection to called unit 218 is completed at step 72.

In a further aspect of the present invention, FIG. 7 shows yet another method of making a communication interconnection. At step 112, MSC 260 receives a call from calling unit 216, designating a called unit 218. Next, upon receipt of a trigger message from MSC 260, HLR 304 checks an airtime allowance account balance of called unit 218 , at step 115. At decision step 116, if the airtime allowance account balance of called unit 218 is sufficient, the communication interconnection to called unit 218 is completed at block 122. If the airtime allowance account balance of called unit 218 is insufficient, then HLR 304 directs MSC 260 to send a message to called unit 218 at step 121. The message indicates that the airtime allowance account balance of called unit 218 is insufficient.

In an additional aspect of the present invention, FIG. 8 shows still another method of making a communication interconnection. At step 92, MSC 260 receives a call from calling unit 216, designating a mobile unit 218. At step 93, during call processing by MSC 260, a trigger point is detected, activating a trigger message. Subsequently, MSC 260 forwards a trigger message to HLR 304, step 94. Next, upon receipt of the trigger message, HLR 304 checks an airtime allowance account balance, at step 95. At decision step 96, if the airtime allowance account balance is sufficient, the communication interconnection to mobile unit 218 is completed at step 102. If the airtime allowance account balance of mobile unit 218 is insufficient, HLR 304 directs MSC 260 to direct the communication interconnection to a management resource, step 97.

At step 98, the subscriber of mobile unit 218 is provided with an option to override its insufficient airtime allowance account balance

via an interactive audio recording VRU 312, provided that the subscriber of mobile unit 218 enters a valid PIN or voice recognized signal. Next, at decision step 99, if the subscriber selects the option to override its insufficient airtime allowance account balance, the communication interconnection to mobile unit 218 is completed at step 102. If the subscriber elects not to override its insufficient airtime allowance account balance, HLR 304 directs MSC 260 to deny the communication interconnection between calling unit 216 and mobile unit 218, step 101.

It will be apparent that other forms of the invention, and embodiments other than the specific embodiments described above, may be devised without departing from the spirit and scope of the appended claims and their equivalents.

CLAIMS

What we claim is:

1. A method of making a communication interconnection comprising the steps of:

transmitting a number from a calling unit designating a called unit;

checking an account balance of said calling unit;

completing said communication interconnection to said called unit if said account balance is sufficient;

interconnecting said calling unit to a management resource if said account balance is insufficient;

providing an option to adjust said account balance; and

completing said communication interconnection to said called unit if said account balance is adjusted and is sufficient.

2. The method according to claim 1 wherein prior to the step of checking the account balance, the method further comprising the steps of:

detecting a trigger; and

sending a message to implement a check on said account balance.

3. The method of claim 1 wherein the step of providing an option to adjust said account balance comprises the steps of:

requesting whether a user of said calling unit desires to adjust said account balance;

instructing that said account balance be adjusted; and

adjusting said account balance.

4. The method of claim 3 wherein the step of instructing that said account balance be adjusted comprises the step of entering a personal identification number.

5. The method of claim 3 wherein the step of instructing that said account balance be adjusted comprises the step of verifying a user's voice using voice recognition.

6. The method according to claim 1 wherein a code division multiple access system communication interconnection is utilized to make the communication interconnection.

7. The method according to claim 1 wherein the calling unit is selected from the group consisting of: a mobile station, a fixed communication station, a pager and a personal data assistant.

8. The method according to claim 1 wherein the management resource is selected from a group consisting of: a mobiles switching center, a visitor location register, a home location register and a voice response unit.

9. The method according to claim 1 wherein the communication interconnection is denied if said account balance is insufficient after being adjusted.

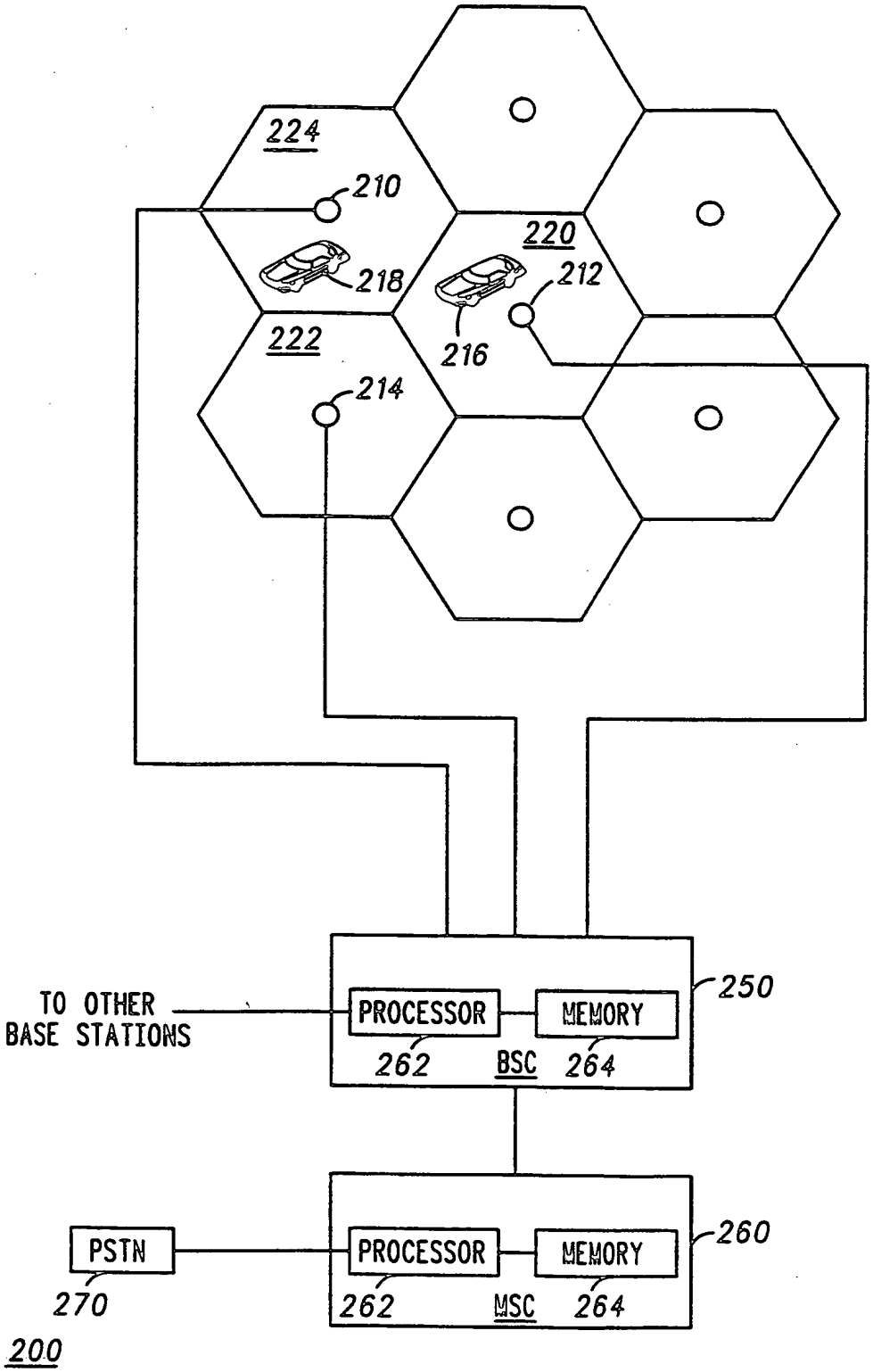

FIG. 1

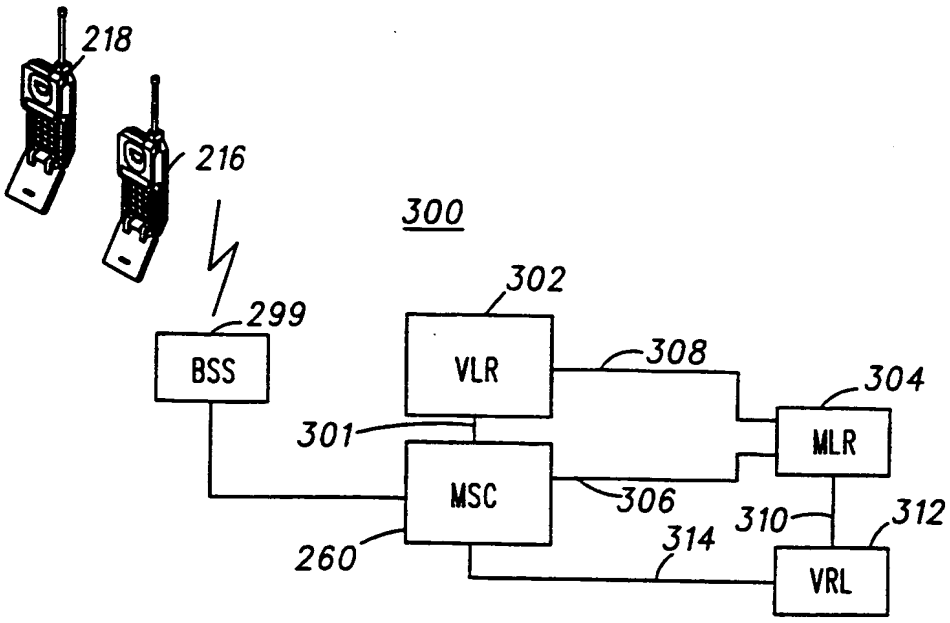

FIG. 2

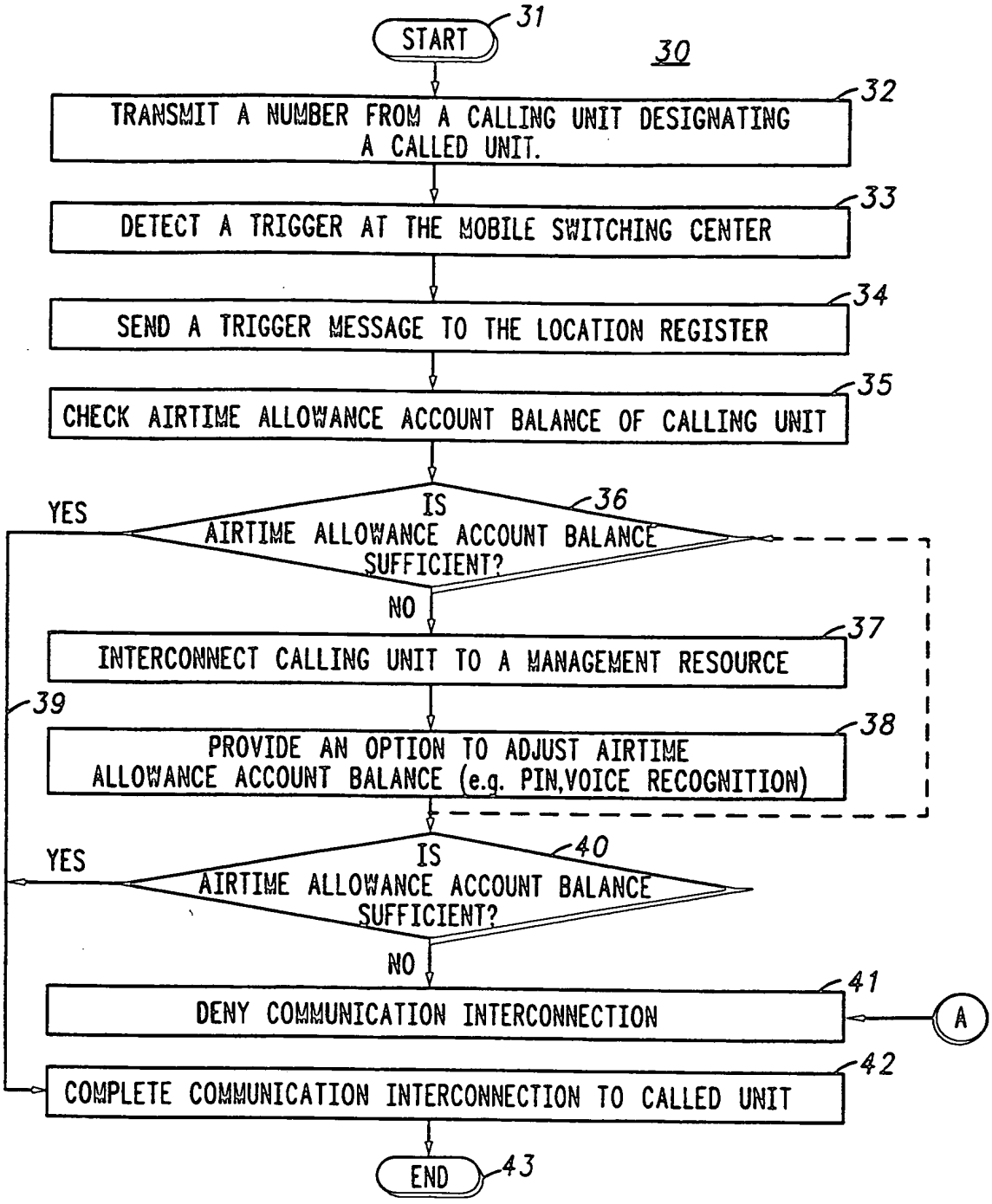

FIG. 3

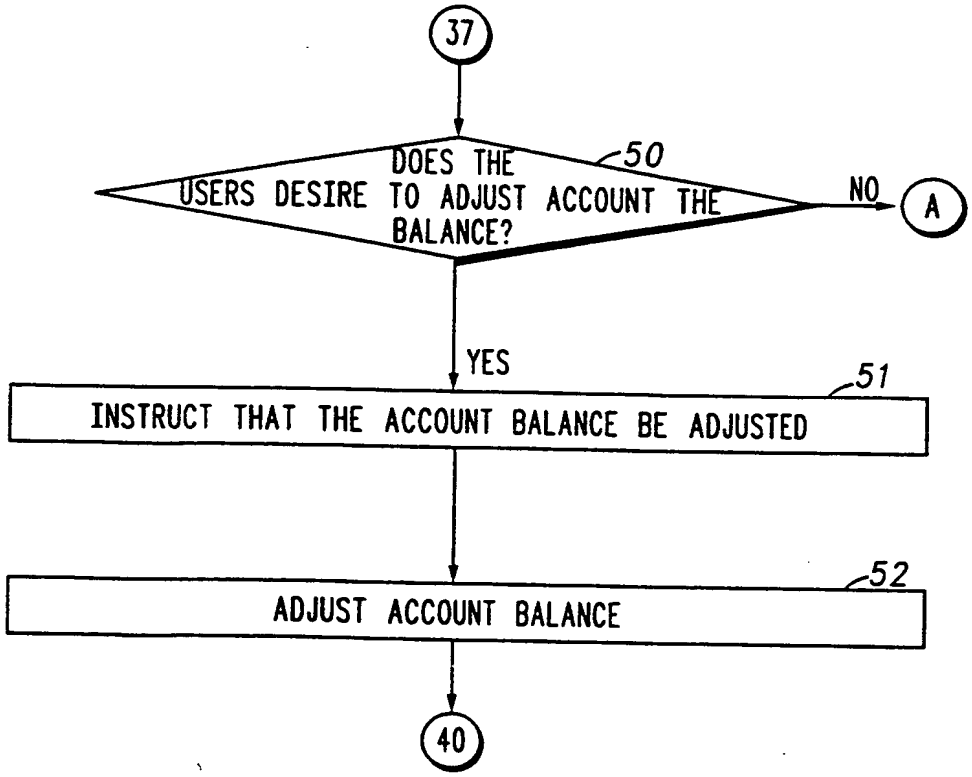

FIG. 4

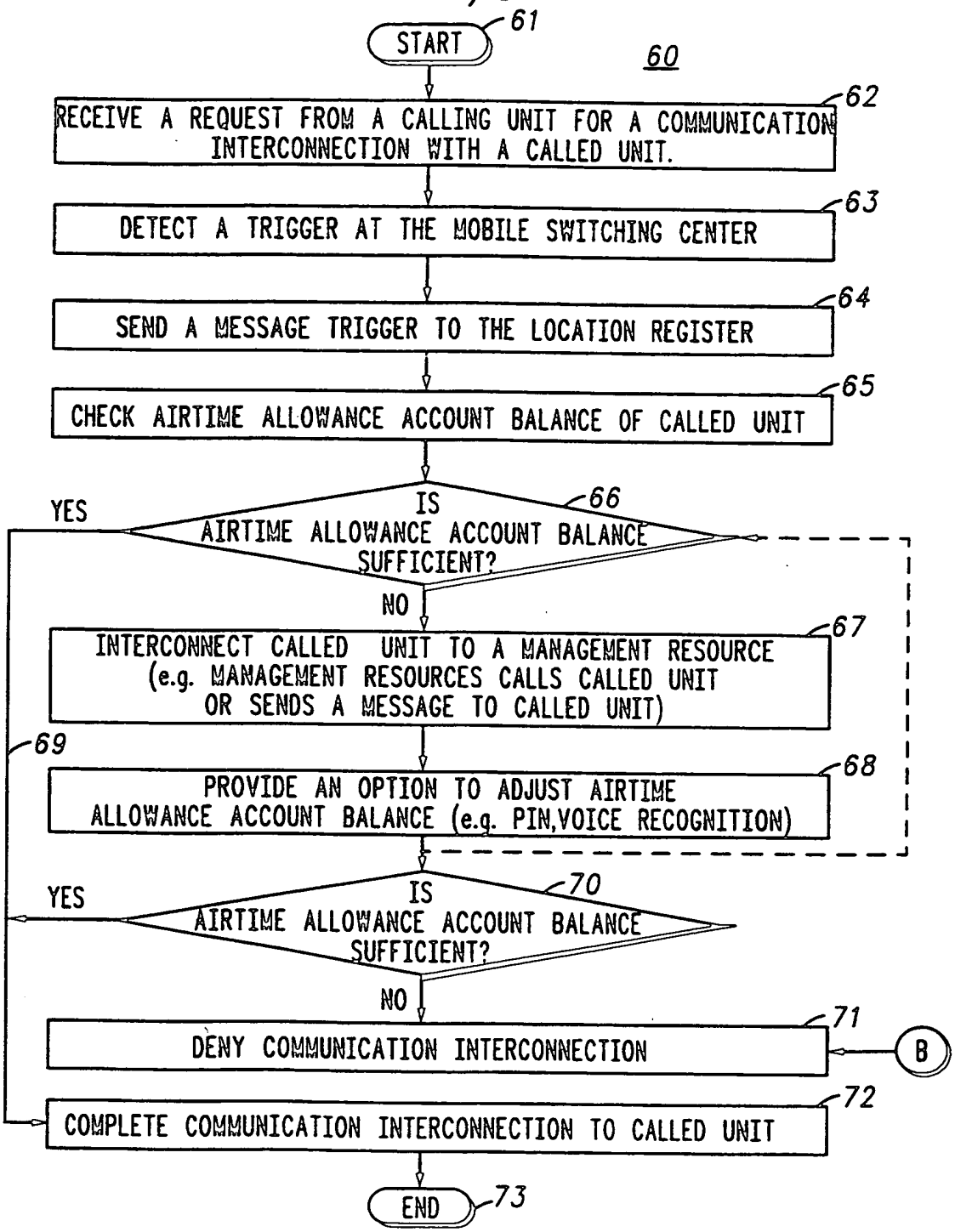

FIG. 5

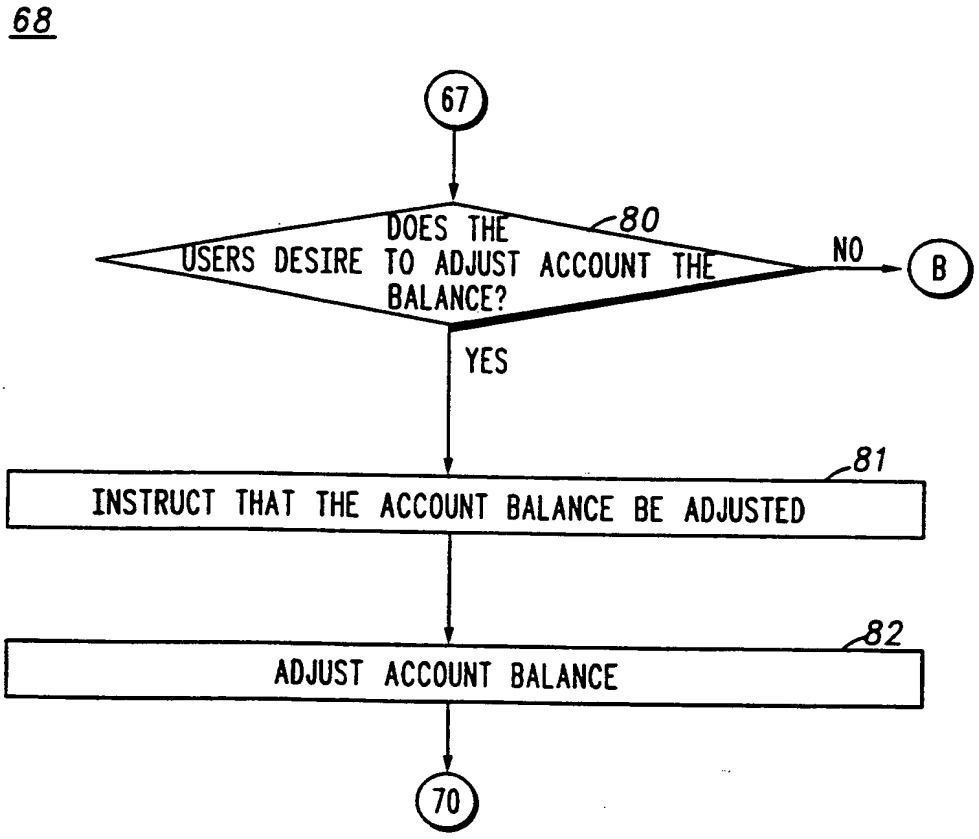

FIG. 6

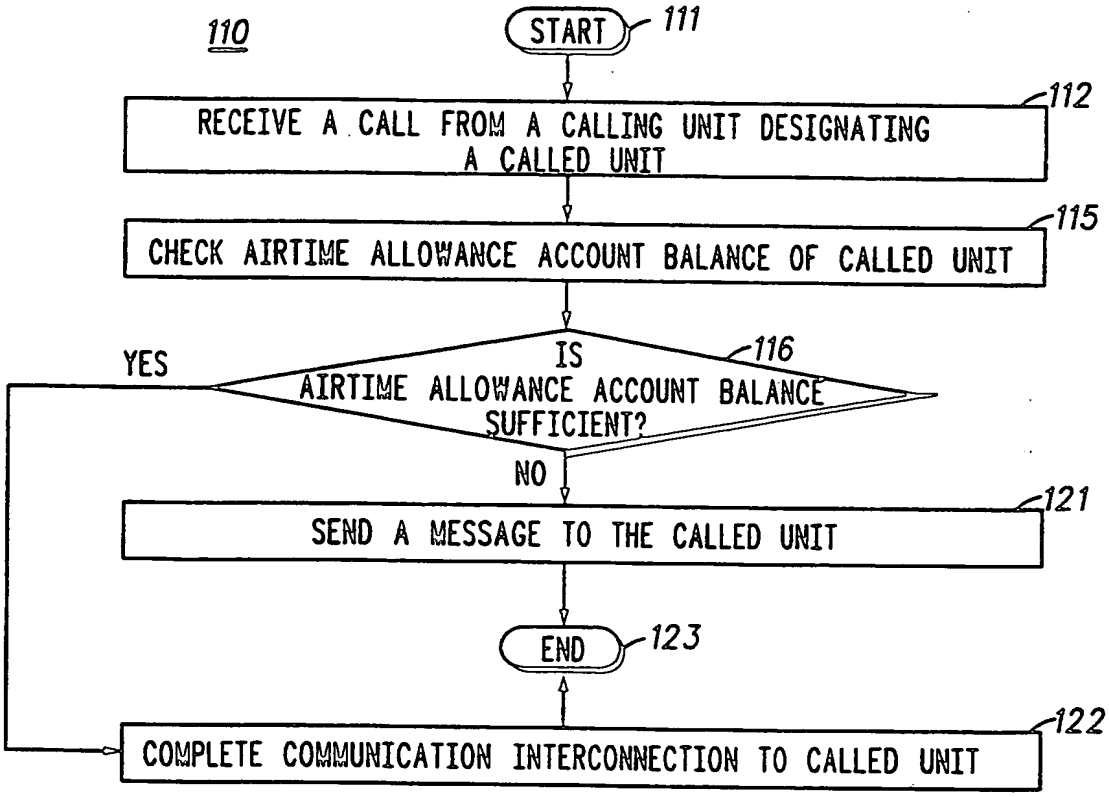
110
START
111
RECEIVE A CALL FROM A CALLING UNIT DESIGNATING A CALLED UNIT
112
CHECK AIRTIME ALLOWANCE ACCOUNT BALANCE OF CALLED UNIT
115
IS AIRTIME ALLOWANCE ACCOUNT BALANCE SUFFICIENT?
116
YES
NO
SEND A MESSAGE TO THE CALLED UNIT
121
END
123
COMPLETE COMMUNICATION INTERCONNECTION TO CALLED UNIT
122

FIG. 7

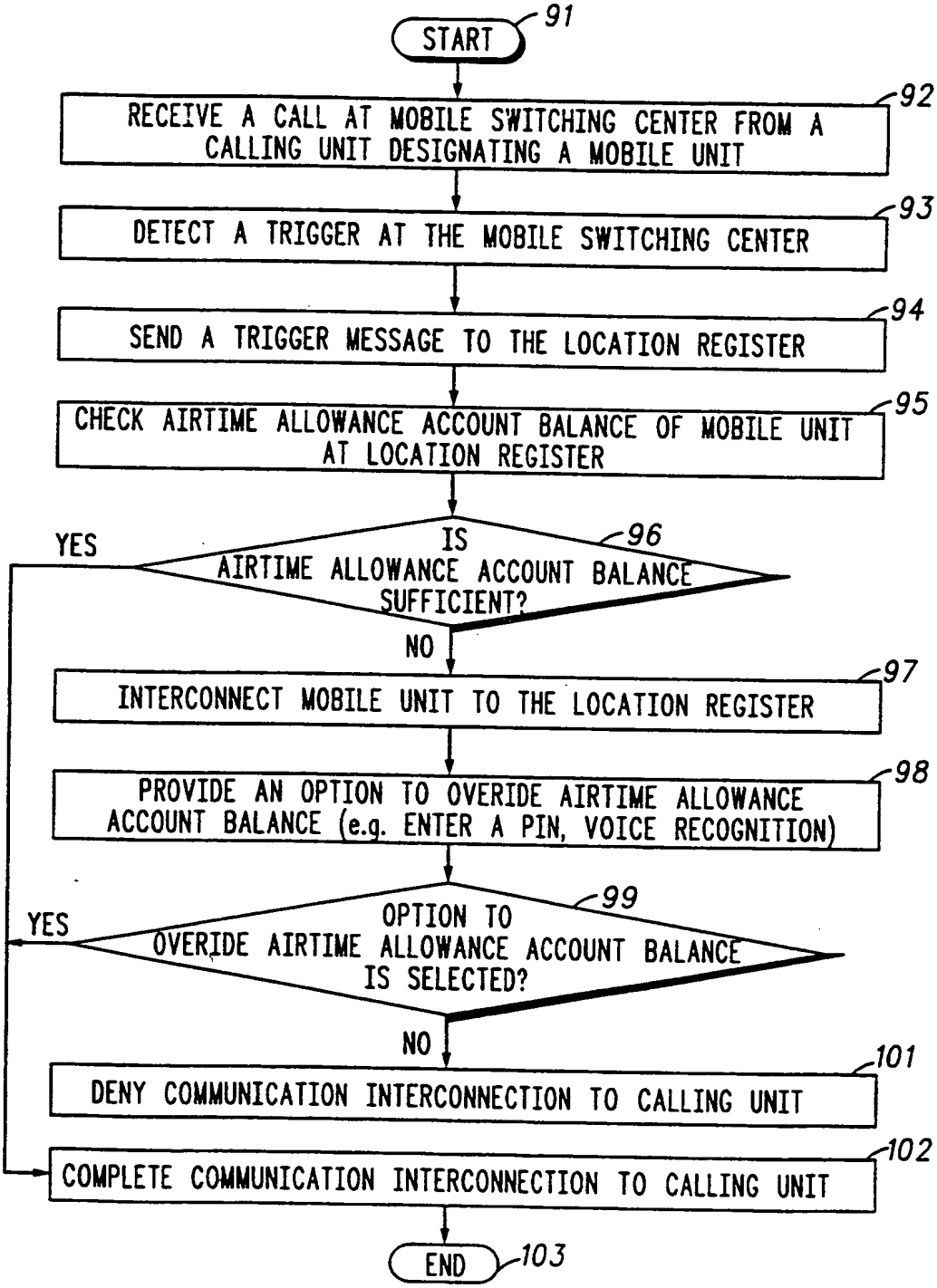

FIG. 8

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US98/08306

A. CLASSIFICATION OF SUBJECT MATTER
IPC(6) :H04M 15/00
US CL :455/406, 411; 379/114, 144
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

U.S. : 455/406, 411, 405, 407-409, 410, 414, 418-420, 560, 433, 422; 379/114, 144, 111-112, 154, 127

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

NONE

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

NONE

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5,291,543 A (FREESE ET AL) 01 March 1994, col. 3 lines 22-46; column 9 lines 20-64.	1-9
Y	US 5,586,175 A (HOGAN ET AL) 17 December 1996, column 94 line 55 to column 95 line 11.	1-9
Y	US 5,577,100 A (MCGREGOR ET AL) 19 November 1996, column 18 lines 15-61.	4-5

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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Date of the actual completion of the international search 09 AUGUST 1998	Date of mailing of the international search report 19 OCT 1998
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